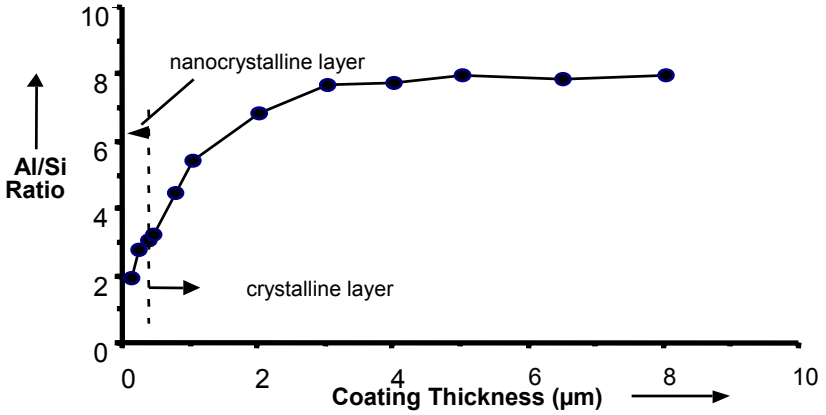
FRG: Functionally Graded High-Al Mullite Environmental Barrier Coatings

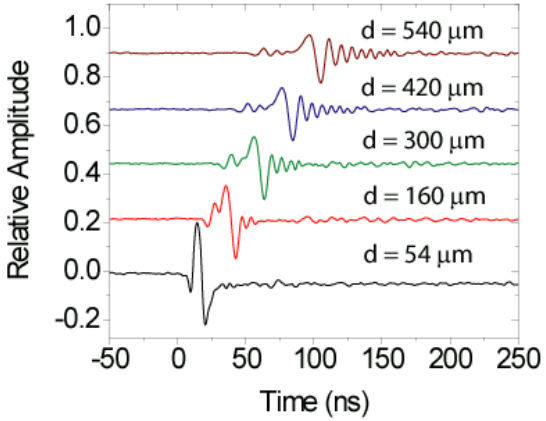
PI Soumendra Basu, Boston University, DMR-0233952

We have grown mullite coatings by chemical vapor deposition (CVD) such that the Al content of the coating increases monotonically from the interface to the coating surface. This functionally graded coating combines good mechanical properties (adhesion, thermal shock resistance) with corrosion resistance.



Composition variation in CVD mullite coating

We are currently working to model and measure the depth dependent mechanical and thermal properties of these coatings on a micron scale. Laser pulses are used to locally heat the coating and excite acoustic waves. Surface acoustic waves are confined to propagate in the near-surface region and are sensitive to the properties of the coating. These waves are detected by an optical probe after some propagation distance, and the frequency dependent velocity characteristics are used to determine coating properties.



Surface acoustic waves detected on a mullite coating as a function of source to receiver distance.

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Education:

One undergraduate (Nicholas Pratt), four graduate students (Thomas Steen, Connie Wei, Wang Xiu, and Oluwaseyi Balogun) and one post-doc (Dr. Tripathi) have contributed to this work. Prof. Murray has incorporated laser based ultrasonic testing of coating materials into a graduate level course on experimental techniques in solid mechanics. Undergraduate Nicholas Pratt won a BU Undergraduate Research Opportunities Program (UROP) summer fellowship.

Outreach:

Undergraduate researcher Nicholas Pratt recently presented his work on laser ultrasonic inspection at the Boston University Undergraduate Research Symposium. Graduate student Oluwaseyi Balogun presented his work on theoretical modeling of laser generated ultrasound in FGM's at the 30th Annual Review of Progress in QNDE conference. The PI's are currently developing a "Science Saturday" module for high school students to come to BU for hands on experiments in SEM structural characterization, FGM characterization and mechanical property measurements.